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Matsumoto et al.

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(54) **HEATING DEVICE, FIXING DEVICE, AND IMAGE FORMING APPARATUS**

(71) Applicant: **FUJI XEROX CO., LTD.**, Minato-ku, Tokyo (JP)

(72) Inventors: **Mitsuhiro Matsumoto**, Kanagawa (JP); **Yasuhiro Uehara**, Kanagawa (JP); **Kazuyoshi Ito**, Kanagawa (JP); **Hideaki Ohara**, Kanagawa (JP); **Mikio Saiki**, Kanagawa (JP); **Hiroki Murakami**, Kanagawa (JP); **Kimiyuki Kawakami**, Kanagawa (JP); **Junji Okada**, Kanagawa (JP); **Tadashi Suto**, Kanagawa (JP)

(73) Assignee: **FUJI XEROX CO., LTD.**, Tokyo (JP)

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G03G 15/20 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/206*** (2013.01); *G03G 15/2053* (2013.01); *G03G 15/2064* (2013.01); *G03G 15/2089* (2013.01); *G03G 2215/2016* (2013.01); *G03G 2215/2032* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/20
USPC 399/329
See application file for complete search history.

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Primary Examiner — Clayton E Laballe
Assistant Examiner — Kevin Butler
(74) *Attorney, Agent, or Firm* — Sughrue Mion, PLLC

(57) **ABSTRACT**

Provided is a heating device that heats a belt which transports a medium on which a non-fixed image to be fixed onto the medium through heating is formed, the heating device including a heating element, a first insulating layer and a second insulating layer that are arranged to nip the heating element, a first supporting layer that comes into contact with the first insulating layer and a second supporting layer that comes into contact with the second insulating layer, both of which are arranged to nip the first insulating layer, the heating element, and the second insulating layer, and a connection member that connects the first supporting layer and the second supporting layer in a normal direction of the first supporting layer and the second supporting layer.

18 Claims, 7 Drawing Sheets

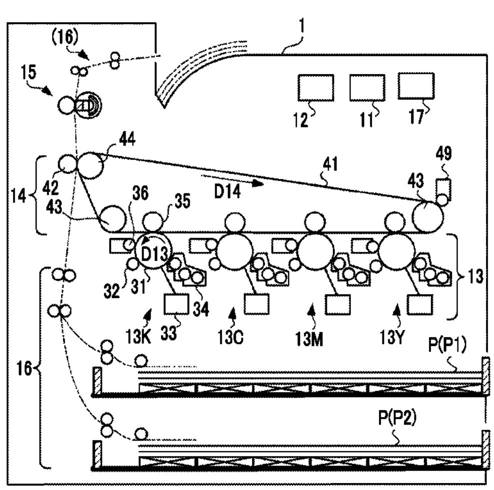

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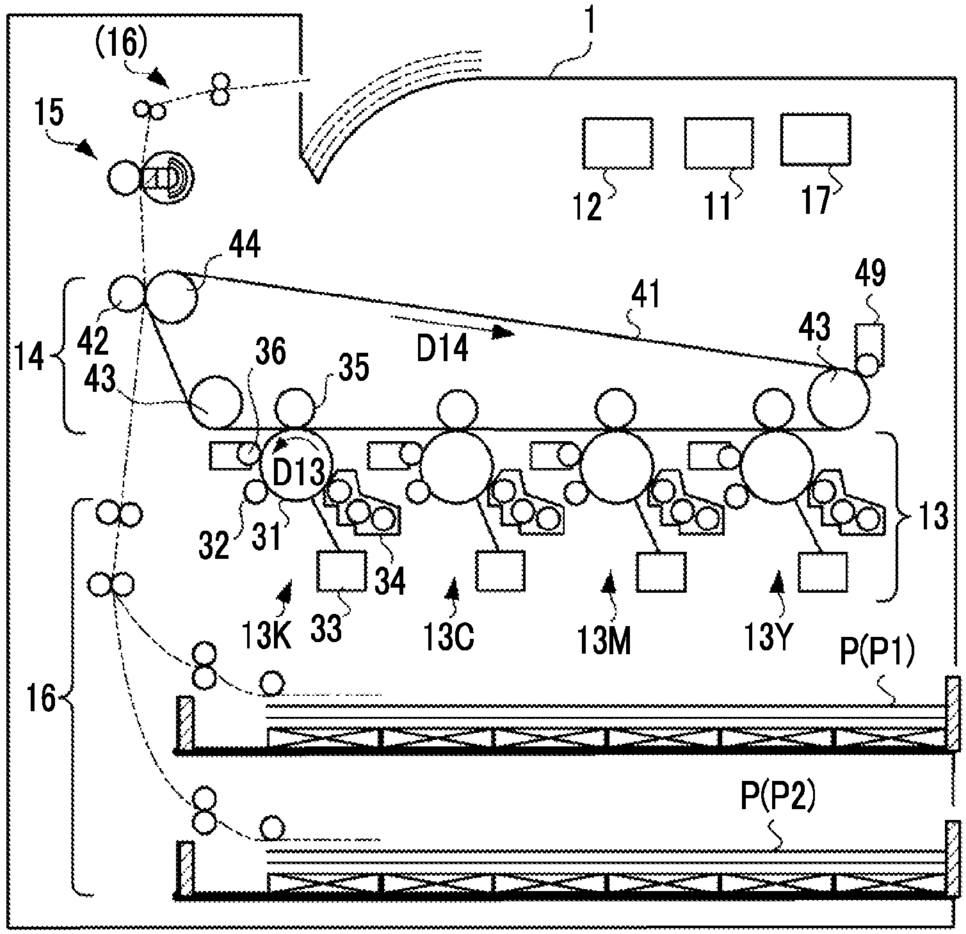
FIG. 1



1
(16)
15
12
11
17
44
41
49
42
43
14
43
36
35
D14
D13
13
32
31
34
33
13K
13C
13M
13Y
16
P(P1)
P(P2)

FIG. 2

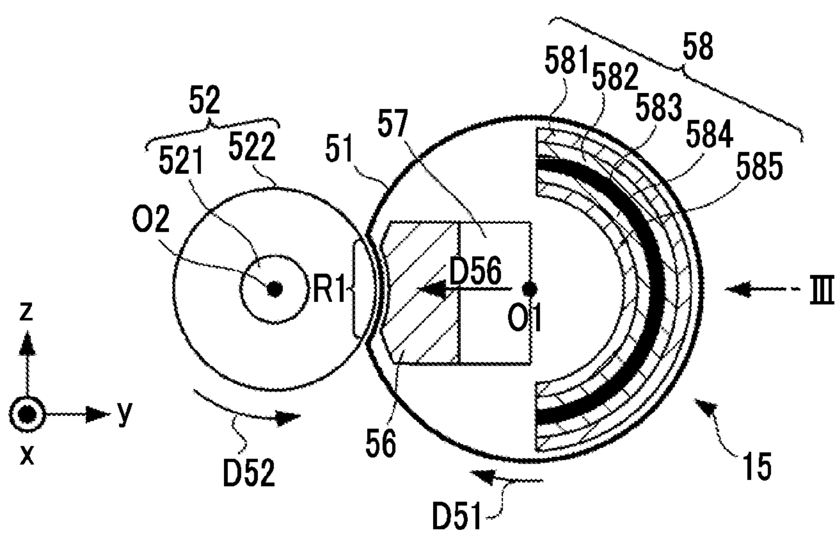

58
581
582
583
584
585
52
521
522
51
57
O2
R1
D56
O1
Ⅲ
z
y
x
D52
56
15
D51

FIG. 3A

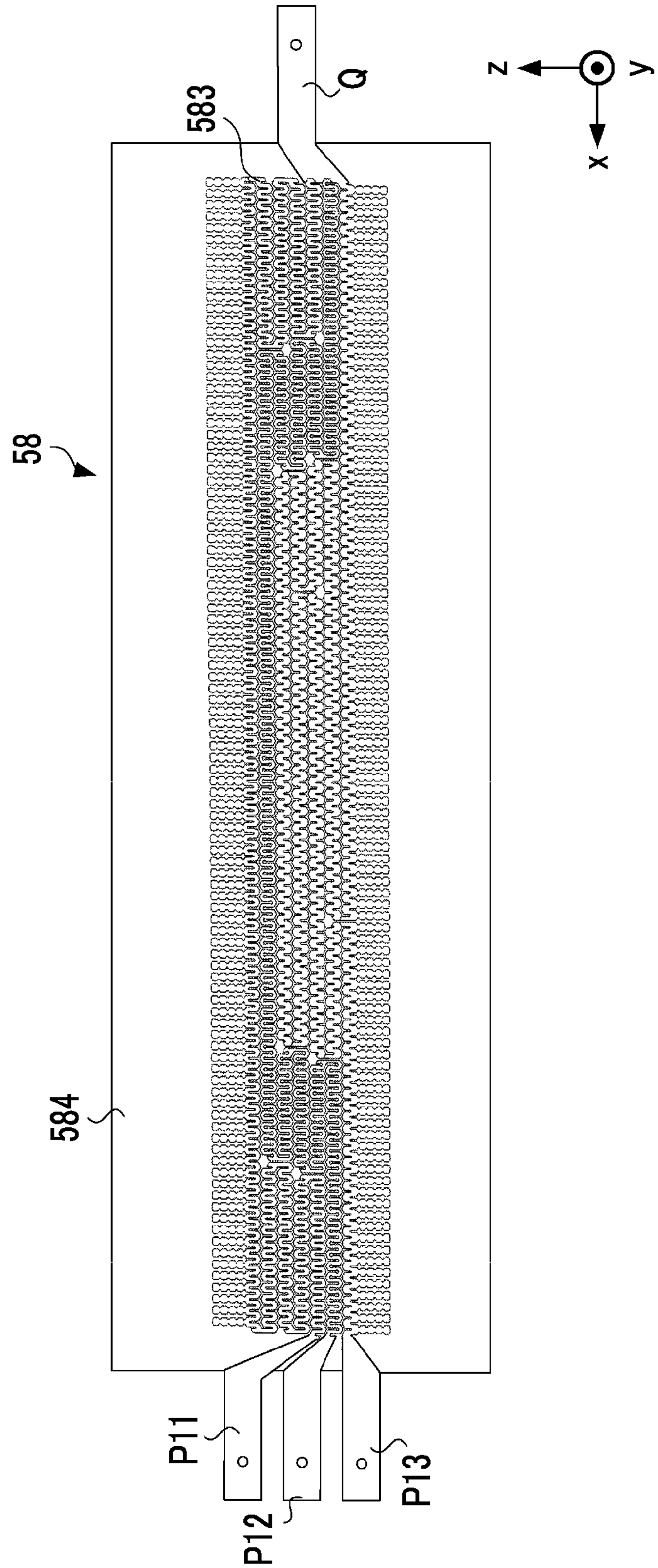


FIG. 3B

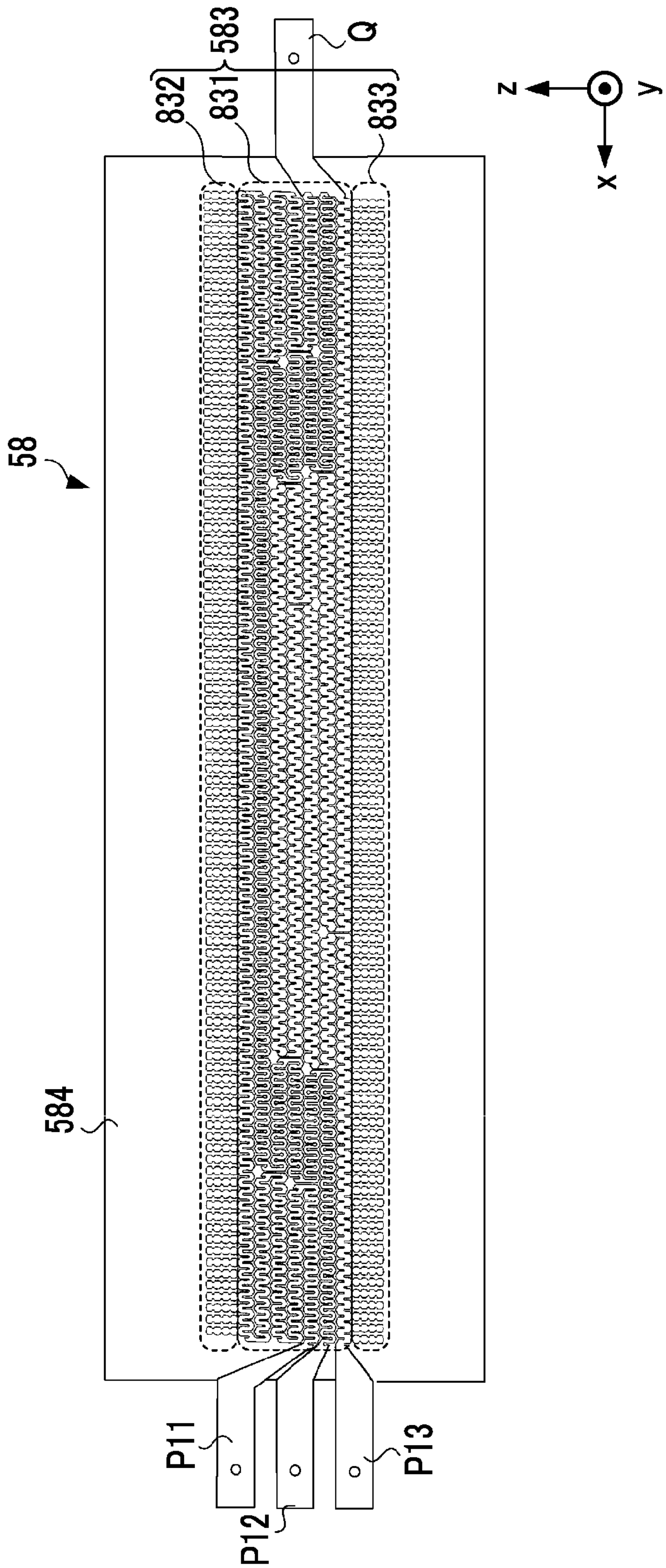


FIG. 4

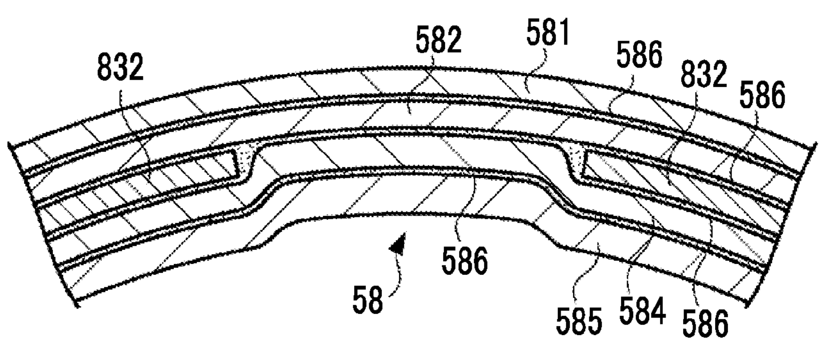


FIG. 5

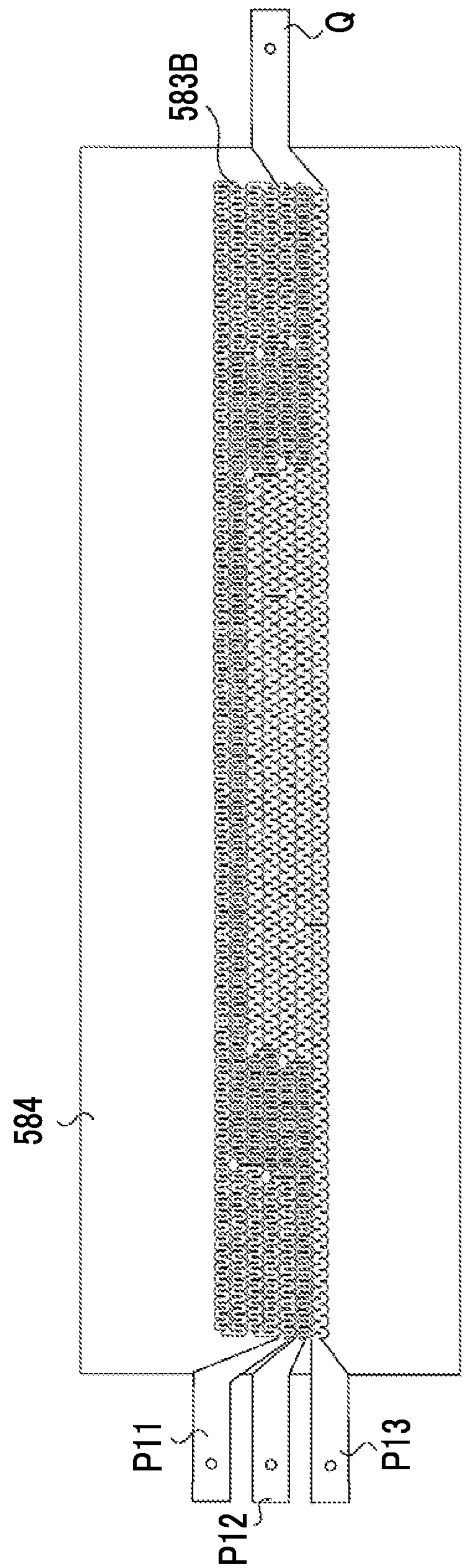
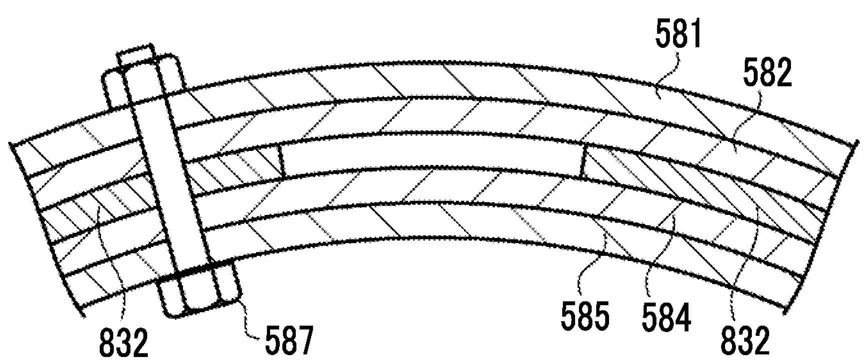


FIG. 6



HEATING DEVICE, FIXING DEVICE, AND IMAGE FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based on and claims priority under 35 USC 119 from Japanese Patent Application No. 2013-252315 filed Dec. 5, 2013.

BACKGROUND

Technical Field

The present invention relates to a heating device, a fixing device, and an image forming apparatus.

SUMMARY

According to an aspect of the invention, there is provided a heating device that heats a belt which transports a medium on which a non-fixed image to be fixed onto the medium through heating is formed, the heating device including:

a heating element;

a first insulating layer and a second insulating layer that are arranged to nip the heating element;

a first supporting layer that comes into contact with the first insulating layer and a second supporting layer that comes into contact with the second insulating layer, both of which are arranged to nip the first insulating layer, the heating element, and the second insulating layer; and

a connection member that connects the first supporting layer and the second supporting layer in a normal direction of the first supporting layer and the second supporting layer.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments of the present invention will be described in detail based on the following figures, wherein:

FIG. **1** is a view illustrating an overall configuration of an image forming apparatus;

FIG. **2** is a view illustrating an overview of a fixing unit;

FIG. **3**A is a view illustrating a heating element viewed from an arrow III of FIG. **2**;

FIG. **3**B is a view illustrating the heating element viewed from the arrow III of FIG. **2**;

FIG. **4** is an enlarged sectional view illustrating a part of the heating unit;

FIG. **5** is a view illustrating an example of a heating element; and

FIG. **6** is an enlarged sectional view illustrating a part of the heating unit.

DETAILED DESCRIPTION

1. Exemplary Embodiment

FIG. **1** is a view illustrating an overall configuration of an image forming apparatus **1** according to an exemplary embodiment of the invention. The image forming apparatus **1** is an apparatus that forms an image by using an electrophotography method. The image forming apparatus **1** according to this exemplary embodiment is of so-called tandem type, and forms the image on a sheet P, which is an example of a medium, based on image data representing the image. A control unit **11** in the drawing has a central processing unit (CPU), a read only memory (ROM), and a random access

memory (RAM), and controls each unit of the image forming apparatus by the CPU reading and executing a computer program (hereinafter, simply referred to as a program) that is stored in the ROM and a storage unit **12**. The storage unit **12** is a large-capacity storage unit such as a hard disk drive, and stores the program that is read by the CPU of the control unit **11**. An operation unit **17** has an operation button and the like, which are used to input various instructions, receives an operation from a user, and supplies a signal, corresponding to a content of the operation, to the control unit **11**.

Developing units **13**Y, **13**M, **13**C, and **13**K form toner images on a sheet P. The signs of Y, M, C, and K mean that these are configured to correspond respectively to yellow, magenta, cyan, and black toner. The developing units **13**Y, **13**M, **13**C, and **13**K have no large difference in configuration from one another, except that the toner which are used are different. Hereinafter, the developing units **13**Y, **13**M, **13**C, and **13**K are referred to as "developing units **13**", with the alphabets showing the colors of the toner at the ends of the respective signs omitted, when the developing units **13**Y, **13**M, **13**C, and **13**K do not have to be distinguished from one another.

Each of the developing units **13** has a photoconductor drum **31**, a charging unit **32**, an exposure device **33**, a developing unit **34**, a primary image transfer roller **35**, and a drum cleaner **36**. The photoconductor drum **31** is an image holding member that has a charge generation layer and a charge transporting layer, and is rotated in an arrow D13 direction in the drawing by a driving unit (not illustrated). The charging unit **32** charges an outer surface of the photoconductor drum **31**. The exposure device **33** has a laser light-emitting source (not illustrated), a polygon mirror (not illustrated), and the like, and irradiates the photoconductor drum **31** that is charged by the charging unit **32** with laser light corresponding to the image data under the control by the control unit **11**. In this manner, a latent image is held in each of the photoconductor drums **31**. The above-described image data may be acquired by the control unit **11** from an external device via a communication unit (not illustrated). Examples of the external device include a reader that reads an original image, and a storage device that stores data showing an image.

The developing unit **34** accommodates toner of any of the Y, M, C, and K colors and a two-component developer containing a magnetic carrier such as ferrite powder. When a tip of a magnetic brush that is formed in the developing unit **34** comes into contact with the outer surface of the photoconductor drum **31**, the toner adheres to a part of the outer surface of the photoconductor drum **31** that is exposed by the exposure device **33**, that is, a streak portion of an electrostatic latent image and the image is formed (developed) in the photoconductor drum **31**.

An intermediate image transfer belt **41** of a transfer portion **14** generates a predetermined potential difference at a position facing the photoconductor drum **31**, and the primary image transfer roller **35** transfers the image to the intermediate image transfer belt **41** by using the potential difference. The drum cleaner **36** removes the non-transferred toner that remains on the outer surface of the photoconductor drum **31** after the image transfer, and removes electricity of the outer surface of the photoconductor drum **31**. In other words, the drum cleaner **36** removes unnecessary toner and a charge from the photoconductor drum **31** in preparation for subsequent image formation.

The transfer portion **14** has the intermediate image transfer belt **41**, a secondary image transfer roller **42**, a belt transport roller **43**, and a backup roller **44**. The transfer portion **14** is a transfer portion that transfers the image, which is formed by the developing units **13**, onto the sheet P, the type of which is determined according to the user operation. The intermediate image transfer belt **41** is an endless belt member, and the belt transport roller **43** and the backup roller **44** stretches the intermediate image transfer belt **41**. At least one of the belt transport roller **43** and the backup roller **44** is provided with a driving unit (not illustrated) that moves the intermediate image transfer belt **41** in an arrow D14 direction in the drawing. The belt transport roller **43** or the backup roller **44** that is not provided with the driving unit is driven to rotate with following the movement of the intermediate image transfer belt **41**. As the intermediate image transfer belt **41** is moved in the arrow D14 direction in the drawing and is rotated, the image on the intermediate image transfer belt **41** is moved to an area nipped by the secondary image transfer roller **42** and the backup roller **44**.

The secondary image transfer roller **42** transfers the image on the intermediate image transfer belt **41** onto the sheet P, which is transported from a transport unit **16**, by using the potential difference between the secondary image transfer roller **42** and the intermediate image transfer belt **41**. A belt cleaner **49** removes the non-transferred toner that remains on an outer surface of the intermediate image transfer belt **41**. Then, the transfer portion **14** or the transport unit **16** transports the sheet P, where the image is transferred, to a fixing unit **15**. The developing unit **13** and the transfer portion **14** are examples of image forming unit that form the image on a medium of the exemplary embodiment of the invention.

The transport unit **16** (example of a transport unit) has containers and transport rollers. The sheet P as an example of the medium, which is cut to a predetermined size and has the non-fixed image, which is fixed onto the medium through heating, formed thereon, is accommodated in the container. As for the size of the sheet P, at least two different sizes are determined in a direction vertical to a transport direction, that is, a width direction. Herein, two types of the sheets P are used, one being a maximum width sheet P**1** and the other being a small width sheet P**2** that is narrower in width than the maximum width sheet P**1**. The maximum width sheet P**1** refers to the sheet having the largest size in the width direction among the sheets P handled by the image forming apparatus **1**. The two types of the sheets P are distinguished by the control unit **11** according to the containers in which the sheets P are accommodated. The sheets P that are accommodated in the respective containers are taken out, sheet by sheet, by the instruction from the control unit **11** and the transport rollers, and are transported to the transfer portion **14** through a sheet transport path. The medium is not limited to the sheet. For example, the medium may be a resinous sheet. In short, the medium may be any medium insofar as the image may be formed on an outer surface of the medium.

The fixing unit **15** (example of a fixing device) fixes the image, which is transferred to the sheet P, through heating. FIG. **2** is a view illustrating an overview of the fixing unit **15**. Hereinafter, a space in which each configuration of the fixing unit **15** is arranged in the drawing is shown as an XYZ right-handed coordinate space to describe the arrangement of each configuration. Of the coordinate symbols illustrated in the drawing, the symbol of a black circle in a circle that is white on the inner side represents an arrow directed from a page face depth side to a front side. In the space, a direction along an X axis will be referred to as an X-axis direction. Of the X-axis direction, a direction in which an X component increases will be referred to as a +X direction and a direction in which the X component decreases will be referred to as a −X direction. A Y-axis direction, a +Y direction, a −Y direction, a Z-axis direction, a +Z direction, and a −Z direction are also defined for Y and Z components. When the sheet P passes through the fixing unit **15**, the sheet P is transported in the Z-axis direction in a state where the surface where the image is formed is directed toward the +Y direction. In other words, the Z-axis direction is the transport direction of the sheet P, and the X-axis direction is the width direction of the sheet P.

The fixing unit **15** has a fixing belt **51**, a pressurizing roller **52**, a pressing pad **56**, a holder **57**, and a heating unit **58**. As illustrated in FIG. **2**, the fixing belt **51** rotates in an arrow D51 direction about an axis O1 that is parallel to the X-axis direction. In addition, as illustrated in FIG. **2**, the pressurizing roller **52** has a metallic and cylindrical core material **521**, and an elastic layer **522** that is disposed on an outer surface of the core material **521**. The core material **521** rotates in an arrow D52 direction about an axis O2, which is an axis parallel to the axis O1 and arranged in the −Y direction of the axis O1, and causes the elastic layer **522** to rotate in the arrow D52 direction. Examples of materials of the elastic layer **522** include a silicone rubber layer and a fluorine rubber layer. In addition, the elastic layer **522** may be provided with an outer surface release layer (fluorine resin layer) on an outer surface of the elastic layer **522**. The pressurizing roller **52** presses the sheet P, which is transported by the transport unit **16**, to the fixing belt **51** while being rotated by a driving unit (not illustrated) to assist in the heating of the sheet P with the fixing belt **51**. The fixing belt **51** is driven to be rotated by the pressurizing roller **52** due to a frictional force from the pressurizing roller **52**.

The pressing pad **56**, the holder **57**, and the heating unit **58** are arranged on an inner circumferential side of the fixing belt **51**. The holder **57** is a rod-shaped member that extends in the X-axis direction, and both end portions (not illustrated) of the holder **57** are fixed to a housing of the image forming apparatus **1**. The holder **57** is formed by using a heat-resistant resin such as glass-filled PPS (polyphenylene sulfide) and a non-magnetic metal such as gold (Au), silver (Ag), aluminum (Al), and copper (Cu). The holder **57** supports the pressing pad **56** to press the pressing pad **56** in an arrow D56 direction (−Y direction) illustrated in FIG. **2**, that is, a direction toward the pressurizing roller **52**.

The pressing pad **56** is formed of a heat-resistant resin such as liquid crystal polymer (LCP), and is supported by the holder **57** at a position facing the pressurizing roller **52**. The pressing pad **56** is arranged in a state where the pressing pad **56** is pressed from the pressurizing roller **52** via the fixing belt **51**, and presses the fixing belt **51** from inside toward the direction (−Y direction) of the pressurizing roller **52**. In this manner, a nip area R**1** is formed between the fixing belt **51** and the pressurizing roller **52**. The sheet P is transported to pass through the nip area R**1**. In the nip area R**1**, the pressing pad **56** is deformed to be recessed toward the axis O1 due to the pressing by the pressurizing roller **52**, and the fixing belt **51** has a shape that follows the deformed shape of the pressing pad **56**. The pressing pad **56** may be formed of an elastomer such as silicone rubber and fluorine rubber.

The heating unit **58** is a member that heats the fixing belt **51**. The heating unit **58** is an example of a heating device according to the exemplary embodiment of the invention. The heating unit **58** is provided with a metal layer **581** (example of a first supporting layer), an insulating layer **582**, a metal layer **583**, an insulating layer **584**, and a metal layer **585** (example of a second supporting layer) that are stacked in this order from an inner circumferential surface side of the fixing belt **51** toward the axis O1. The heating unit **58** has a shape in which a rectangular planar member, where the metal layer **581**, the insulating layer **582**, the metal layer **583**, the insulating layer **584**, and the metal layer **585** are laminated, is curved in an arc shape about the axis O1. The heating unit **58** has a plane size of, for example, approximately 100 mm×400 mm in a non-curved state. The heating unit **58** may be formed by being curved after the metal layer **581**, the insulating layer **582**, the metal layer **583**, the insulating layer **584**, and the metal layer **585** that have planar shapes are laminated, or may be formed by laminating the metal layer **581**, the insulating layer **582**, the metal layer **583**, the insulating layer **584**, and the metal layer **585** that have curved shapes.

In this exemplary embodiment, the metal layer **581** is a stainless steel layer with a thickness of 10 μm to 100 μm. The metal layer **581** has functions as a temperature equalizer and a heat-accumulation material. In addition, the metal layer **581** functions to prevent floating and peeling, which are caused by a thermal expansion of the metal layer **583** and the insulating layers **582** and **584**, by using rigidity of the metal layer **581**. A surface of the metal layer **581** on the side opposite to the insulating layer **582**, that is, an outer surface that is an outer side when the heating unit **58** has an arc shape, comes into contact with the fixing belt **51** to support the fixing belt **51**. Examples of shapes of the metal layer **581** include a shape in which a part corresponding to a range (for example, 30° to 180°) of a predetermined central angle is cut from an alloy formed into a cylindrical shape with the thickness described above. However, the shape is not particularly limited.

The metal layer **583** is covered by the insulating layer **582** and is positioned inside the metal layer **581**. In this exemplary embodiment, the metal layer **583** is disposed over a direction (longitudinal direction of the heating unit **58**) that intersects with the arrow D51 direction, which is the direction in which the fixing belt **51** is moved.

FIGS. **3**A and **3**B are views illustrating the metal layer **583**, viewed from an arrow III of FIG. **2**, through the metal layer **581** and the insulating layer **582**. FIGS. **3**A and **3**B illustrate the metal layer **583** and the insulating layer **584** with planar shapes, instead of the heating unit **58** being curved, so as to facilitate the understanding of the configuration of the metal layer **583**. In this exemplary embodiment, the metal layer **583** is obtained by cutting a thin stainless steel plate with a thickness of 10 μm to 100 μm into the shapes illustrated in FIGS. **3**A and **3**B. The metal layer **583** may be formed of another material insofar as the material generates heat.

As illustrated in FIG. **3**B, the metal layer **583** has a heat generating portion **831** (example of a heating element), and non-heat generating portions **832** and **833** (examples of a non-heating element). The heat generating portion **831** and the non-heat generating portions **832** and **833** are integrally formed as illustrated in FIG. **3**A, and the metal layer **583** has a certain degree of rigidity. Electrodes P**11** to P**13** and an electrode Q are disposed in the metal layer **583**, and a power source (not illustrated) is connected between each of the electrodes P**11** to P**13** and the electrode Q. The heat generating portion **831** generates heat when electric current flow from these power sources. An area (hereinafter, referred to as a "heated area") of the metal layer **581** relating to the heat generating portion **831** is heated by the heat generation by the heat generating portion **831**, and the heat is transmitted to the fixing belt **51** in contact with the heated area such that the fixing belt **51** is heated. Slight heat generation is performed also on the non-heat generating portions **832** and **833**, but the heat generation performed on the non-heat generating portions **832** and **833** is insufficient to heat the fixing belt **51**.

Referring back to FIG. **2**, the insulating layers **582** and **584** of this exemplary embodiment are highly heat-resistant insulating layers of, for example, a polyimide resin, an insulation vapor deposited film, and thin film ceramic. The insulating layer **582** is disposed on a lower surface side of the metal layer **581** and covers and protects the metal layer **583**. The insulating layer **584** is disposed on an upper surface side of the metal layer **585** and covers and protects the metal layer **583**. The material of the insulating layers **582** and **584** is not limited to the polyimide resin, and may be any other resin insofar as the material is heat-resistant.

In this exemplary embodiment, the metal layer **585** is a stainless steel layer with a thickness of 10 μm to 100 μm. The metal layer **585** supports the metal layer **583**, the insulating layer **582**, and the insulating layer **584**, and functions to prevent the floating and the peeling, which are caused by the thermal expansion of the metal layer **583** and the insulating layers **582** and **584** by using rigidity of the metal layer **585**. Examples of shapes of the metal layer **585** include a shape in which a part corresponding to a range (for example, 30° to 180°) of a predetermined central angle is cut from an alloy formed into a cylindrical shape with the thickness described above. However, the shape is not particularly limited.

FIG. **4** is an enlarged sectional view illustrating a part of the heating unit **58**. The metal layers **581** and **585**, the insulating layers **582** and **584**, and the metal layer **583** are adhered with a thermoplastic adhesive **586** (example of a connection member) in a part of an area other than the heated area (hereinafter, referred to as a "non-heated area") or in the entire non-heated area. In other words, the metal layers **581** and **585**, the insulating layers **582** and **584**, and the metal layer **583** are adhered in the area other than the area where the heat generating portion **831** illustrated in FIGS. **3**A and **3**B is positioned. The shapes of the metal layer **581**, the insulating layer **582**, the metal layer **583**, the insulating layer **584**, the metal layer **585**, and the adhesive **586** therebetween, which are illustrated in FIG. **4**, are an example and may be changed to various shapes by, for example, the rigidity and viscosity of these members. The adhesive **586** adheres outer surfaces of the metal layers **581** and **585**, the insulating layers **582** and **584**, and the metal layer **583** that face each other. In other words, the adhesive **586** connects the metal layer **581** and the metal layer **585** in the normal direction of the metal layer **581** and the metal layer **585**.

In fixing devices of the related art, a heat generating portion has a higher temperature than an insulating layer, particularly at a timing immediately after an initiation of heat generation, when the heat generating portion and the insulating layer has the same thermal expansion coefficient and when the thermal expansion coefficient of the heat generating portion is higher than the thermal expansion coefficient of the insulating layer. Accordingly, the amount of expansion of the heat generating portion is greater than the amount of expansion of the insulating layer, and a gap (floating and peeling) is generated between the heating element and the insulating layer. This becomes more remarkable when an adhesive force between the heating element and the insulating layer is reduced by use over time at an abnormally high temperature. When the gap is generated between the heat generating portion and the insulating layer, the heat that is generated by the heat generating portion may not be moved to a fixing belt and the fixing belt may not be heated to a predetermined temperature. This results in fixing failures in some cases.

Another problem is that the highly heat-resistant insulating layer is subjected to change such as embrittlement and carbonization, due to an abnormally high temperature caused by an individual heating state (so-called boiling state) of the heating element, when a metal plate is laminated on a side where the heating element and the fixing belt are in contact with each other and the gap (floating and peeling) is generated. As a result, an insulating function is reduced and electric currents flowing in the heating element leak to the metal layer to cause a low resistance area to be formed on a circuit. In this case, combined resistance of the heat generating portion is reduced and abnormal heat generation or the like occurs in some cases.

In contrast, in this exemplary embodiment, the metal layer **581** and the metal layer **585** are connected with the adhesive in the normal direction of the surfaces thereof, and thus the insulating layer **582** and the insulating layer **584**, which are nipped between the metal layer **581** and the metal layer **585** are pressed from outside with respect to the metal layer **583** arranged therebetween. As a result, the gap formation (occurrence of the floating and the peeling) is suppressed between the metal layer **583** and the insulating layers **582** and **584**.

In addition, in this exemplary embodiment, the laminated body of the insulating layer **582**, the metal layer **583**, and the insulating layer **584** is arranged to be nipped, and the metal layer **581** and the metal layer **585**, which are adhered to the laminated body, are deformed to be curved such that the heating unit **58** is formed. A circumferential direction distance of an inner side surface of the heating unit **58** is shorter than a circumferential direction distance of an outer side surface of the heating unit **58**, and thus the metal layer **585**, in which any of the direction along the surfaces is suppressed by the adhesive **586** during the curving deformation, generates a force toward an outer side of the surface in the normal direction and presses the laminated body of the insulating layer **582**, the metal layer **583**, and the insulating layer **584** to the metal layer **581**. As a result, adhesion between the insulating layer **582** and the metal layer **583** and adhesion between the metal layer **583** and the insulating layer **584** are higher than when the curving deformation is not performed. As such, the gap formation is suppressed.

In addition, in this exemplary embodiment, the thermoplastic adhesive is employed as the adhesive **586**. Accordingly, when the metal layer **583** generates heat and reaches a high temperature, liquidity of the adhesive **586** in the vicinity thereof increases. Even when a misalignment is generated between the layers constituting the heating unit **58** due to the difference between the thermal expansion coefficients, the adhesive **586** maintains the adhesion state while allowing the misalignment. Then, when the heat generation of the metal layer **583** is stopped and the temperature is decreased, the adhesive **586** in the vicinity thereof maintains the adhesion state while allowing the misalignment and gradually reducing the liquidity. As such, the gap formation between the metal layer **583** and the insulating layers **582** and **584** is more suppressed than when the connection between the layers constituting the heating unit **58** is performed by other units such as a thermally curable adhesive and a screw. In addition, the adhesive **586** and the insulating layer **582** or the insulating layer **584** may be films that are integrally formed from the beginning. Further, the exemplary embodiment of the invention is available, if stress conditions and temperature conditions are appropriate, even when the above-described effect of the thermoplastic resin is absent, that is, when the metal layer **581**, the insulating layer **582**, and the like are adhered with the thermally curable resin alone.

2. Modification Example

The exemplary embodiment of the invention has been described above. The invention is not limited to the exemplary embodiment described above and may be embodied in various manners. The examples are as follows. In addition, the respective aspects below may be combined with each other.

(1) The metal layers **581** and **585**, the insulating layers **582** and **584**, and the metal layer **583** are adhered in the non-heated area of the metal layer **581** in the exemplary embodiment described above. However, both the heated area and the non-heated area may be adhered. Even in this case, the metal layer and the insulating layer adhere to each other in the non-heated area, and thus the gap formation is suppressed between the heating element and the insulating layer. In addition, the adhesion is performed also in the heated area, and a force suppressing the gap formation increases.

(2) The metal layer **583** that has the heat generating portion **831** and the non-heat generating portions **832** and **833** is used in the exemplary embodiment described above. However, for example, a metal layer **583**B (refer to FIG. **5**) that does not have the non-heat generating portions **832** and **833** may be used.

(3) The heating unit **58** with a curved shape is used in the exemplary embodiment described above. However, the shape of the heating unit is not limited to the shape described in the exemplary embodiment described above. For example, the heating unit may have a non-curved shape. Even in this case, the metal layer and the insulating layer are adhered in the non-heated area, and thus the gap generation is suppressed between the heating element and the insulating layer.

(4) The thermoplastic adhesive is used as the connection member that connects the metal layer and the insulating layer in the exemplary embodiment described above. However, the connection member is not limited to the connection member described in the exemplary embodiment above. For example, as illustrated in FIG. **6**, the non-heated area may be mechanically fixed by using a fixing member **587** such as a screw. In addition, the adhesive and the fixing member **587** such as the screw may be used in combination as the connection member.

(5) The image forming apparatus that includes the fixing unit **15** is not limited to the tandem type of the exemplary embodiment described above, and may have another configuration such as a rotary type. In addition, the image forming apparatus that includes the fixing unit **15** is not limited to the image forming apparatus that forms the image by stacking the toner images of plural colors, and may be an image forming apparatus that forms a single-colored toner image.

The foregoing description of the exemplary embodiments of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obviously, many modifications and variations will be apparent to practitioners skilled in the art. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, thereby enabling others skilled in the art to understand the invention for various embodiments and with the various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents.

What is claimed is:

1. A heating device that heats a belt which transports a medium on which a non-fixed image to be fixed onto the medium through heating is formed, the heating device comprising:

a heating element;

a first insulating layer and a second insulating layer that are arranged to nip the heating element;

a first supporting layer that comes into contact with the first insulating layer and a second supporting layer that comes into contact with the second insulating layer, both of which are arranged to nip the first insulating layer, the heating element, and the second insulating layer; and a connection member that is configured to connect the first supporting layer and the second supporting layer in a normal direction of the first supporting layer and the second supporting layer,

wherein the connection member is configured to connect the first supporting layer and the second supporting layer in the normal direction of the first supporting layer and the second supporting layer in an area where the heating element is absent,

wherein the connection member is configured to not connect the first supporting layer and the second supporting layer in the normal direction of the first supporting layer and the second supporting layer in an area here the heating element is present.

2. The heating device according to claim **1**,

wherein a laminated body that includes the first insulating layer, the first supporting layer, the heating element, the second insulating layer, and the second supporting layer is curved in a state where the first supporting layer and the second supporting layer are connected in the normal direction.

3. The heating device according to claim **2**,

wherein the connection member includes a thermoplastic adhesive that adheres two of the first insulating layer, the first supporting layer, the heating element, the second insulating layer, and the second supporting layer that are adjacent to each other.

4. The heating device according to claim **2**,

wherein the connection member connects the first supporting layer and the second supporting layer in the normal direction of the first supporting layer and the second supporting layer in an area where the heating element is absent.

5. The heating device according to claim **4**, further comprising:

a non-heating element that continues from the heating element,

wherein the first insulating layer and the second insulating layer are arranged to nip the non-heating element, and

wherein the connection member connects the non-heating element to the first insulating layer and the second insulating layer.

6. The heating device according to claim **2**, further comprising:

a non-heating element that continues from the heating element,

wherein the first insulating layer and the second insulating layer are arranged to nip the non-heating element, and

wherein the connection member connects the non-heating element to the first insulating layer and the second insulating layer.

7. The heating device according to claim **3**,

wherein the connection member connects the first supporting layer and the second supporting layer in the normal direction of the first supporting layer and the second supporting layer in an area where the heating element is absent.

8. The heating device according to claim **3**, further comprising:

a non-heating element that continues from the heating element,

wherein the first insulating layer and the second insulating layer are arranged to nip the non-heating element, and

wherein the connection member connects the non-heating element to the first insulating layer and the second insulating layer.

9. The heating device according to claim **7**, further comprising:

a non-heating element that continues from the heating element,

wherein the first insulating layer and the second insulating layer are arranged to nip the non-heating element, and

wherein the connection member connects the non-heating element to the first insulating layer and the second insulating layer.

10. The heating device according to claim **1**,

wherein the connection member includes a thermoplastic adhesive that adheres two of the first insulating layer, the first supporting layer, the heating element, the second insulating layer, and the second supporting layer that are adjacent to each other.

11. The heating device according to claim **10**,

wherein the connection member connects the first supporting layer and the second supporting layer in the normal direction of the first supporting layer and the second supporting layer in an area where the heating element is absent.

12. The heating device according to claim **10**, further comprising:

a non-heating element that continues from the heating element,

wherein the first insulating layer and the second insulating layer are arranged to nip the non-heating element, and

wherein the connection member connects the non-heating element to the first insulating layer and the second insulating layer.

13. The heating device according to claim **11**, further comprising:

a non-heating element that continues from the heating element,

wherein the first insulating layer and the second insulating layer are arranged to nip the non-heating element, and

wherein the connection member connects the non-heating element to the first insulating layer and the second insulating layer.

14. The heating device according to claim **1**,

wherein the connection member connects the first supporting layer and the second supporting layer in the normal direction of the first supporting layer and the second supporting layer in an area where the heating element is absent.

15. The heating device according to claim **14**, further comprising:

a non-heating element that continues from the heating element,

wherein the first insulating layer and the second insulating layer are arranged to nip the non-heating element, and

wherein the connection member connects the non-heating element to the first insulating layer and the second insulating layer.

16. The heating device according to claim **1**, further comprising:

a non-heating element that continues from the heating element,

wherein the first insulating layer and the second insulating layer are arranged to nip the non-heating element, and

wherein the connection member connects the non-heating element to the first insulating layer and the second insulating layer.

17. A fixing device comprising:

a belt that transports a medium on which a non-fixed image to be fixed onto the medium through heating is formed; and the heating device according to claim **1** in which the first supporting layer is arranged to come into contact with the belt.

18. An image forming apparatus comprising:

an image forming unit that forms a non-fixed image to be fixed onto the medium through heating on the medium;

a transport unit that transports the medium on which the non-fixed image is formed by the image forming unit; and

the fixing device according to claim **17** which fixes the non-fixed image onto the medium that is transported by the transport unit.

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